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DEPARTMENT OF TRANSPORTATION

Evaluating Bicycle, Pedestrian, Transit and Economic Data Collection Needs and Measures of Effectiveness in Pennsylvania

FINAL REPORT

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Evaluating Bicycle, Pedestrian, Transit and Economic Data in Pennsylvania

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16. Abstract The purpose of this research project was to evaluate the current data collection procedures for bicycle and pedestrian projects utilized by the Pennsylvania Department of Transportation (PennDOT) and Pennsylvania's Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs). The evaluation has assessed how additional data collection could support Measures of Effectiveness (MOEs) for planning and design activities. Current limitations of bicycle and pedestrian data collection were identified through an extensive review of PennDOT publications, Pennsylvania MPOs and RPOs current practices, survey of participating organizations in bicycle and pedestrian projects and detailed analysis of five selected and completed bicycle/pedestrian projects. Project goals and MOEs have been identified and recommendations have been provided regarding data collection and analysis methods to support Long Range Transportation Plans (LRTP), project development processes, and agency (PennDOT, MPO/ROP, Local Governments) roles.		



Evaluating Bicycle, Pedestrian, Transit and Economic Data in Pennsylvania

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Introduction

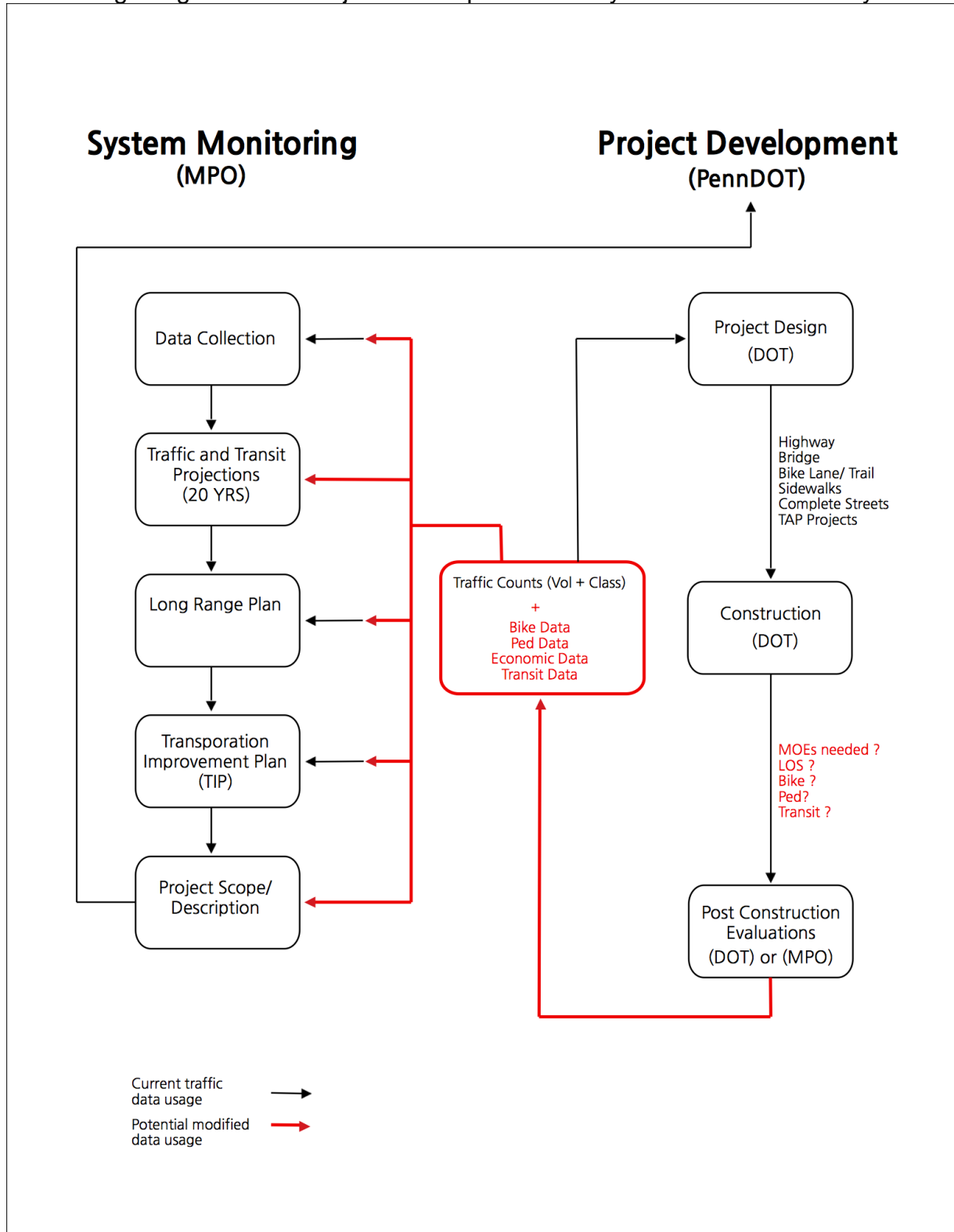
The purpose of this research project was to evaluate the current data collection procedures for bicycle and pedestrian projects utilized by the Pennsylvania Department of Transportation (PennDOT), Pennsylvania's Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs). Once these collection methods were known, the research team assessed whether additional data collection could support Measures of Effectiveness (MOEs) for planning and design activities.

Data collected for bicycles, pedestrians, transit, economics, and other factors that would help evaluate bicycle and pedestrian projects or support the reporting of MOEs were reviewed. This literature search included current research and practices on a national, state and local government level that could potentially be implemented in Pennsylvania. The development of MOEs could be used to track system performance for active transportation projects and help planners identify strategic opportunities for investment during the planning and programming process in Pennsylvania.

The collection and use of bicycle and pedestrian data should be an important component of any process that defines and implements transportation projects. The following Figure 1 illustrates how the processes used by PennDOT and MPOs/ RPOs currently consider utilization of these data as part of the project development and system performance processes for Pennsylvania and regions. The highlighted areas in the figure show where the process could potentially be improved with additional data.



Figure 1
Integrating Data into Project Development and Systems Performance Systems



The goals of this research project were achieved by performing the following tasks:

- Task 1 - Literature review of current research and practices
- Task 2 - An evaluation of current Pennsylvania data collection methods and utilization
- Task 3 - The development of management goals and measures of effectiveness for Pennsylvania
- Task 4 - Case studies of current bicycle and pedestrian projects to determine how data is currently being used
- Task 5 - Recommendations to improve the project development process, project programming and PennDOT and MPO system performance

Tasks 1 and 2 provided a detailed literature review of current research and practices of other states in the areas of bicycle and pedestrian data collection and utilization to support the project development and planning process. The tasks also examined how PennDOT and Pennsylvania MPOs and RPOs currently collect and use these data to support their transportation planning and design activities in Pennsylvania.

Task 3 collected additional data through surveys of PennDOT, MPOs, and RPOs responsible for bicycle and pedestrian project planning and development. Based on Tasks 1, 2 and 3, preliminary recommendations on goals and MOEs for Pennsylvania were provided.

Task 4 evaluated five (5) case studies. The evaluations provided insight on how specific projects in Pennsylvania have used data and analysis methods to plan and design bicycle and pedestrian projects. The results of these case studies were used to further consider the preliminary recommendations of the Task 3 report.



Literature Research

This literature review was intended to provide a baseline of information on current academic research and general practices in collecting and using bicycle and pedestrian data to support the goals of Departments of Transportation (DOTs), MPOs, RPOs and local governments. Because the incorporation of bicycle and pedestrian features into the transportation system is key to developing multimodal networks, there was a need to identify the various data types, collection methods and potential applications of the collected data. The literature review explored current information in both academic research and current DOT, MPO, RPO and local government practices.

The academic research explored the areas of long range planning, project development and data collection methods/technologies that are being developed. Current research to measure and predict the benefits of these types of transportation improvements has also been considered. Additionally, benefits beyond the traditional activity level measures including economic, health and other secondary benefits of bicycle and pedestrian activities were reviewed.

The current practices of data collection were reviewed by the types and levels of government agencies. A review of current methodologies and practices recommended and used by the United States Department of Transportation (USDOT), state DOTs, MPOs and local governments were all evaluated.

The following provides a summary of the literature review.

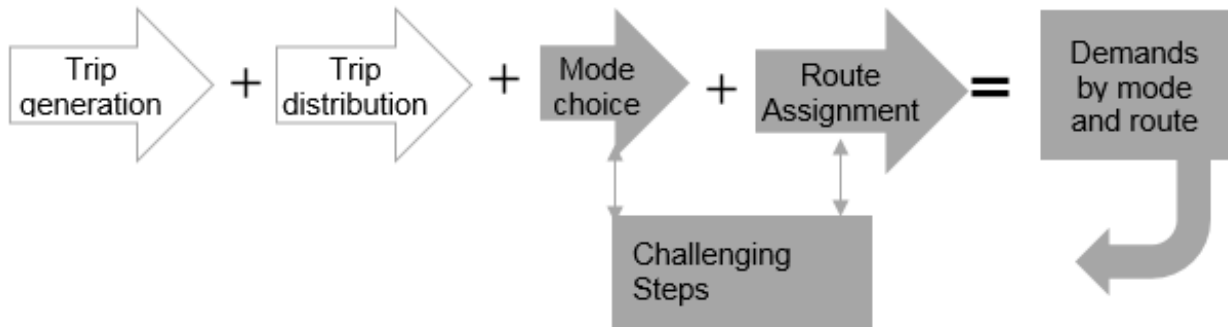
I. Academic Research

The current academic research review provided insight into the methods, technologies, and types of data that could potentially be used to improve the multimodal planning process in Pennsylvania. This review included planning methods, the project development process, data collection (including technologies), integrating transit into planning methods, economic considerations and MOEs.

The literature review revealed that the planning of “active transportation” amenities, such as bicycle and pedestrian travel features, challenges the conventional planning process in different ways such as unclear mode choice and non-existent route characteristics. These active transportation travel activities may depend on demographics (individual and household characteristics), the built environment, and elements of transportation system design. Figure 2 illustrates the steps in the four step process that are challenging for prediction of bicycle and pedestrian travel activity.



Figure 2
Four Step Process Challenges for Bicycle and Pedestrian Modes



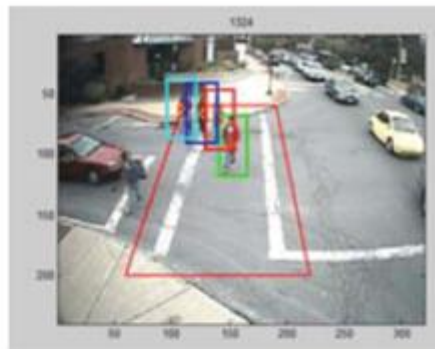
Also, to collect bicycle and pedestrian data, many new technologies are being developed. The accuracy must be considered when selecting a method because these are mostly sample counts; however, the process used to adjust the sample data, to reflect longer duration data, is also very important. The technologies currently being used are shown in Figure 3.

Figure 3
Bicycle and Pedestrian Counting Technologies



Source: Frank Proulx, UC Berkeley SafeTREC.

Technician installing video camera.



Source: Ling et al. (2010).

Detection of pedestrians using automated video counting.



Source: Karla Kingsley, Kittelson & Associates, Inc.

Bicyclist riding over pneumatic tubes.



Source: Clara Schlichting, Toole Design Group.

Technicians setting up a passive infrared counter.

Integrating transit into planning methods is important because researchers [Mohanty et. al. 2016] revealed that sidewalk width and presence of pedestrian crossings significantly affect transit use by improving accessibility to transit stops. It was predicted that wide sidewalks would encourage transit use among 87.5% of the population and adequate pedestrian crossings would encourage transit use among 99.5% of the population.

Similarly, among bicycle infrastructure variables, plentiful on-board transit vehicle capacity for bicycles was estimated to encourage transit use among 94.2% of the population.

To measure the MOEs of transportation projects, Level of Service (LOS) is the most commonly accepted method, but perhaps the most commonly used method of estimating benefits of active transportation projects is the direct measurement of usage. Instead of measuring pedestrian perceived level of service, a better measure of effectiveness is pedestrian activity, as suggested by the research. It is customary to predict pedestrian activity using the D variables: development density, land use diversity, street network design, destination accessibility, distance to transit, and demographics.

The evaluation of current research in bicycle and pedestrian planning, data collection methods, integration of transit into planning, economic considerations and MOEs has revealed many new innovations that guided this research. There are also many challenges that still exist in this area of transportation planning. Promising innovations that were considered in this study for Pennsylvania included:

- New bicycle and pedestrian demand estimation methods within the traditional four step transportation planning model and outside of the model using more specific land use and infrastructure characterization data
- Evolving analysis methodologies for Pedestrian LOS (PLOS), Bicycle LOS (BLOS) and Multimodal LOS (MMLOS)
- Project prioritization tools for both bicycle and pedestrian project ranking
- System data collection tools to monitor usage, system characteristics and safety to measure benefits over time

Challenges that still exist that need to be met to collect and use data include:

- Data collection method technologies that provide a higher degree of accuracy and characterization of users
- Data adjustment factors or standardized methods to create adjustment factors to convert sample data methods to measure broader benefits to society of active transportation projects



II. USDOT Policies and Guidance

The USDOT has recently provided important policies and guidance to states and local governments regarding methods to collect data and plan for bicycle and pedestrian facilities. This section of the literature review summarizes information identified in these areas.

The USDOT has taken initiatives to provide safer streets for non-motorized travel through [Safer People, Safer Streets: Pedestrian and Bicycle Safety Initiative 2015]. The policy initiative addresses bicycle and pedestrian trends over the past decade and observes increasing cycling and walking rates since the year 2009. They provided extensive guidance on data collection methods and technologies, which is based upon the experience of individual states through implemented programs and research.

The USDOT's Guidebook for Developing Pedestrian and Bicycle Performance Measures provides guidance for stakeholders to measure the performance of pedestrian and bike amenities [Semler et al. 2016]. The guidebook includes seven (7) goals and thirty (30) supporting performance measures, which are summarized in Table 1.



Table 1

Bike and Pedestrian Project Goals and Performance Measures Recommended by the USDOT

Performance measure	Goals						
	Connectivity	Economic	Environment	Equity	Health	Livability	Safety
Access to destinations	x	x	x	x	x	x	x
Access to jobs	x	x		x			
Adherence to accessibility	x	x		x	x	x	x
Adherence to traffic laws					x		x
Average travel time	x	x		x		x	x
Average trip length	x	x		x		x	x
Connectivity index	x	x		x		x	x
Crashes				x	x	x	x
Crossing opportunities	x			x	x	x	x
Delay				x		x	x
Density of destinations	x	x		x	x	x	x
Facility maintenance	x			x		x	x
Job creation		x					
Land consumption		x	x			x	
Land value		x					
Level of service				x		x	x
Miles of ped/ bike facilities	x			x	x	x	x
Mode split			x	x	x	x	
Network completeness	x	x	x	x	x	x	x
Pedestrian space		x		x		x	x
Person throughput		x		x			
Physical activity and health				x	x	x	
Pop. served by non-motorized	x			x	x	x	x
Retail impacts		x					
Route directness	x	x	x	x		x	x
Street trees			x		x	x	x
Serving disadvantaged populations	x			x			
User perceptions					x	x	x
VMT impacts			x		x	x	x
Volume			x		x		x



Current USDOT recommendations and survey of practices can assist Pennsylvania in developing methods. Items determined to be of benefit for the development of recommendations in Pennsylvania include:

- USDOT guidance on goals and MOEs for Transportation Alternatives Program (TAP) projects, which is the funding category used for many bicycle and pedestrian improvement projects in Pennsylvania
- An evaluation of current technology and data collection programs that provides a critique of expectations of technologies and standardized data collection programs
- Identification of MOEs that are recommended for consideration of measuring the benefits of bicycle and pedestrian projects
- Guidance on how to incorporate quantifiable benefits into a benefit/cost analysis for bicycle and pedestrian projects

III. State DOT, MPO and Local Government Practices

A review of the practice of DOTs, MPOs and local governments gave insight into how Pennsylvania may wish to consider the collection of data and use of this information in the planning and project development process.

Many states have developed methods to collect and analyze data for planning and design purposes. The California Department of Transportation (Caltrans) looked at the performance measure framework which is structured around a set of strategic agency goals. The goals relate to the Complete Streets directive and the Green Streets movement, as well as expanding it to include a focus on pedestrians and bicyclists [Sanders et al. 2014].

New York State Department of Transportation (NYSDOT) has published a statewide Bicycle and Pedestrian Plan [NYS Bike/Ped Plan 1997] that recognizes the State's primary role to provide technical assistance, to make appropriate funding resources available, and to enable communities to develop the transportation infrastructure best suited to their local conditions.

Florida DOT has begun quantifying data by developing the financial impact of pedestrian fatalities and injuries. By gathering data from multiple agencies, the plan was able to include a variety of analyses. These analyses included data such as percentages of pedestrian traffic fatalities by the nature of injury, pedestrian traffic fatalities by age and year, pedestrian crashes by time of day and month, and many other factors in Florida.



Ultimately, the goal of the plan is to reduce the annual number of fatalities and serious injuries for pedestrians and bicycles by 5%.

MPOs are responsible for determining long range transportation needs, including project prioritization and selecting which projects receive funding. Different MPOs have adopted various prioritization methods, including some of the examples below:

- The Memphis Tennessee MPO recognizes the need to increase bicycle and pedestrian travel, and they developed a bicycle and pedestrian plan in hopes of aiding local jurisdictions in the project selection process [Bicycle and Pedestrian Plan 2014]. They have also developed a plan of integrating the public into the project prioritization process.
- Florida's regional planning agencies have a list of over 200 performance measures that they use to assess their multimodal network.
- Capital Area Metropolitan Planning Organization (CAMPO) of Austin, Texas has developed a list of projects based on the levels of funding for each mode.
- Miami-Dade MPO measures the percent increase in the number/mileage of facilities.
- Oregon Metro MPO measures the number of daily bicycle trips and walking trips, which is done on a regional basis for all mobility corridors. They also keep track of the percentage of regional bicycle and pedestrian systems completed.
- Boston Region MPO measures the status of their bicycle and pedestrian network by documenting if it is located within 0.5-1 mile of transit stations.

Local governments have started looking at the way cities take shape and how non-motorized transportation plays a role in developing an economically prosperous community. Billings, Montana has created benchmarks to measure the effectiveness of their Complete Street Policy [TMACOG 2014]. The New York City (NYCDOT) measures the before and after conditions of a project to determine whether their goals have been met [NYCDOT 2012]. The District of Columbia DOT also evaluated bicycle facilities with respect to design flaws, types of users attracted to protected facilities, operational and safety trade-offs with autos, and compliance with traffic laws [Performance Measures Guidebook 2016].



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The review of DOT, MPO and local government practices in bicycle and pedestrian planning provides valuable insight for Pennsylvania. The practices vary by level of government, as expected, and are summarized as follows:

- DOTs generally provide the overall framework for bicycle and pedestrian planning and project support. Some statewide MOEs are developed related to safety and other statewide typical transportation related goals.
- MPO practices concentrate on project selection and some MOEs. Much of this activity relates to allocation of funds available for bicycle and pedestrian projects and how to prioritize these.
- As expected, local governments in urban areas have adopted many of the more specific policies and practices in bicycle and pedestrian planning. NYCDOT has developed very specific goals and MOEs and tracks these on an ongoing basis.

The measurement of benefits for bicycle and pedestrian modes and projects is an evolving practice. Many traditional benefits, such as safety and activity levels, are being measured. Predicting or forecasting activity levels for planning purposes and evaluating potential benefits of projects is not being practiced in a manner such as highway benefit evaluations. Tracking funds expended on bicycle and pedestrian projects is a common measurement of benefits used by many government agencies. The following Table 2 summarizes the goals and MOEs identified and used by DOTs and MPOs.



Table 2

Summary of DOT and MPO Bike and Pedestrian Planning and Measurement Methods

Reference	Mode	Goals and performance measures						
		Mobility	Safety	Connectivity	Equity	Environment	Public health	Other*
Seattle DOT (2014)	B	D	Q	Q	Q			Q
Washington State DOT (2008)	B, P	M (PM)	M (PM)		Q (PM)	Q (PM)	Q (PM)	
Minnesota DOT (2016)	B, P	D (PM)	Q (PM)	Q (PM)	D			
NYC DOT (2010)	P	M (PM)	Q					
City of Austin (2014)	B	D (PM)	D (PM)	**	Q (PM)	**	**	
City of San Francisco (2009)	B	M	D	Q				
Illinois DOT (2014)	B	D	D			D	D	D
Alabama DOT (2010)	B, P			Q				
Colorado DOT (2015)	B, P	M, Q (PM)	D (PM)		Q (PM)	D (PM)	D (PM)	Q (PM)
Hawaii DOT (2013)	P	D (PM)	D (PM)	Q (PM)		D (PM)	Q (PM)	Q (PM)
Maryland DOT (2014)	B, P	Q (PM)	D (PM)	Q (PM)	Q (PM)			

Mode included is either bike (B) or pedestrian (P)

* Other goal categories include livability, traveler experience, and employment.

Goals are either measurable (M), directional (D), or qualitative (Q). See supporting text for descriptions.

"PM" indicates performance measures specified



IV. Summary

The literature review was completed to establish a baseline of information on current academic research and general practices in collecting and using bicycle and pedestrian data to support state DOTs', MPOs', RPOs' and local governments' goals.

The review included academic research into the areas of long range planning, project development and data collection methods/technologies. Current research to measure and predict the benefits of these types of transportation improvements has also been considered. The current practice was also reviewed by the types and levels of government agencies.



Current Pennsylvania Data Collection Methods and Utilization

PennDOT and Pennsylvania's MPOs and RPOs have developed methods and policies to use bicycle and pedestrian data in both the project development and LRTP process.

The following provides a summary of current practice in Pennsylvania, including the current policies and guidelines that have been developed to collect and analyze data to assist with planning for these types of non-motorized facilities. This review includes current information available from PennDOT and Pennsylvania transportation planning agencies, including design guides, engineering manuals, handbooks, and performance measures.

I. PennDOT Publications

Eleven (11) publications and policies of PennDOT were reviewed for references to bicycles and pedestrians in the data collection, planning or design process. The most relevant items identified include:

- The Bicycle and Pedestrian Checklist from Design Manual Part 2 specifies the current process to determine the need for bike/ped facilities and is the only formal process that specifies how to determine the need and design features.
- Several documents provide design guidance for intersections and traffic control devices that specify data collection for design purposes.
- Safety publications and programs evaluated pedestrian and bicycle crash data for study and project development purposes.
- The Transportation Advisory Committee (TAC) Bicycle and Pedestrian Policy Study [TAC 2016] is the most comprehensive framework in this area and it recommends that PennDOT should establish MOEs and an updated project development process for bicycles and pedestrians.
- PennDOT Publication 70M indicates design considerations for bikeway facilities and pedestrian facilities. It also emphasizes the safety of pedestrians, bicyclists and the motoring public as the number one priority.

These documents provided a baseline of current PennDOT policies and procedures and were considered in development of the recommendations.



II. Pennsylvania MPOs and RPOs

In Pennsylvania, many MPOs and RPOs have established their own methods of data collection and MOEs. This section provides a summary of the information obtained.

The RPOs that were researched were very small and contained few specific details on a handful of projects expected to be delivered within the upcoming years. There was not much information in terms of data collection plans or project planning.

Many of the MPOs and RPOs within Pennsylvania address non-motorized transportation needs in their LRTP. The following are examples of their practices.

- Adams County MPO recognizes the need to assess the current system with respect to accessibility, use, capacity, connectivity, energy efficiency, and safety.
- Centre County MPO LRTP has eight (8) goals relating to safety, preservation, operations, connectivity, accessibility, context sensitive design, air quality, and economic vitality.
- Blair County is a member of the Healthiest Cities and Counties Challenge and has identified the need to increase active transportation opportunities for its residents to encourage a more active lifestyle.

Local municipal governments, MPOs and RPOs in Pennsylvania have taken different approaches regarding data collection plans and methods. Most of the data collection methods used by MPOs and local governments involve public participation, pneumatic tubes, or infrared technology. Public participation is the most popular for RPOs, because it is the least expensive. Another alternative to counting is supply and demand analysis, which is more comprehensive and requires additional effort, but can provide helpful results. Currently practiced methods for all types of agencies, are summarized below:

- The City of Pittsburgh conducts annual bike counts, which are done by the public and follow the National Bicycle and Pedestrian Documentation Process (NBPD).
- Centre County MPO has expressed a desire to conduct an inventory of missing links in the bicycle and pedestrian systems and has included an implementation strategy in their LRTP.
- The Harrisburg Area Transportation Study (HATS) implemented the Bicycle Suitability Index (BSI) method to analyze supply (bike/ped facilities and infrastructure) and demand (high activity areas).



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- The Delaware Valley Regional Planning Commission (DVRPC) performs short-duration bicycle and pedestrian counts as well as year-round counts with pneumatic tubes.
- Lancaster County calculates a BLOS score, which essentially captures the level of comfort experienced by a bicyclist.
- The Southwestern Pennsylvania Commission (SPC) established an advisory group in 2000 to oversee bicycle and pedestrian planning in the region.



However, the current state of the practice in Pennsylvania includes no data collection procedures that complement the nature of bicycle and pedestrian features and respective demands. Since bicycle and pedestrian demands in the U.S. are typically much lower than volumes of motorized roadway traffic, uncertainty in existing administrative data describing motorized roadway traffic likely masks any mode shifting of existing motorized roadway trips to bicycle and pedestrian activities. As a result, existing safety and roadway volume data collection programs are likely insufficient for evaluating bicycle and pedestrian feature MOEs (and thus higher level goals). These conditions create an opportunity for PennDOT to improve upon this process through the integration of data into the decision making.

MPOs have established goals and MOEs for their regions and are supporting these by data collection efforts that include both direct collection by the agencies and volunteer efforts. They also provide design guidance to local governments for the development of bicycle and pedestrian facilities.



III. Summary

This review of current practices for data collection and utilization in Pennsylvania identified positive movement towards creating a more multimodal transportation system in Pennsylvania on a state, MPO/RPO and local government level. But, the information also revealed that PennDOT does not have a uniform approach to collecting data or analyzing this information except for the Bicycle and Pedestrian Checklist that is used for project planning and design purposes.

The review of current practices by PennDOT and the Pennsylvania MPOs determined that there is no current consistent practice for purposes of planning or project development except the current PennDOT design manual process. Many MPOs and local governments have developed their own guidance for project selection and system MOEs, which reflect their local goals. A summary of these findings is as follows:

Innovations and Opportunities:

- Evolving planning methods that project usage and measure utilization using levels of service and the traditional four (4) step planning process were identified in research activities.
- Public policy guidance on goals, MOEs and project prioritization for bicycle and pedestrian projects is being developed.
- New methods to incorporate quantifiable benefits into a benefit/cost analysis for bicycle and pedestrian projects are being created.
- In Pennsylvania, the Transportation Advisory Commission report provides a framework for PennDOT to establish MOEs and an updated project development process.
- MPOs in Pennsylvania have established goals and MOEs for their regions and are supporting these by data collection efforts.

Challenges:

- A review of current technology and data collection programs reveals that counting technologies are still evolving, and sample data collection requires standardized data collection and volume adjustment methods.
- Methods to measure LOS for bicycles, pedestrians and multimodal highways are still evolving as defined by the Highway Capacity Manual.



- Pennsylvania lacks a uniform approach to collecting data or analyzing this information.



Survey Results

The purpose of the survey was to provide a Pennsylvania perspective of how bicycle/pedestrian data collection and analysis methods are being used in the long-range planning and project development process. Also, the survey sought to obtain information on goals and MOEs considered important to agencies in Pennsylvania. The organizations most directly involved in planning and project development are the PennDOT Districts and the MPOs/RPOs (Planning Partners). Each of these organizations has differing roles and perspectives on the practices and expectations of bicycle and pedestrian projects. This survey identified practices and perspectives for use in the development of the recommendations.

I. Introduction and Purpose of Survey

The survey was structured to solicit important information in the following areas:

- Identify the organization type responding to the survey (PennDOT, MPO, RPO)
- Report the organization's responsibilities in the project development process
- Determine the action that initiates the consideration of bike and pedestrian infrastructure in the organization
- Request information on the use of data and methods used when planning and designing bicycle and pedestrian infrastructure
- Obtain information on each organization's goals and MOEs that they consider important when making decisions about bicycle and pedestrian infrastructure and ranking those goals and MOEs
- Request for information on specific projects for which bicycle, and/or pedestrian data was collected and analyzed for the consideration of candidate case studies

II. Survey Responses

The survey was performed to obtain information from individuals from PennDOT, MPOs and RPOs involved in bicycle/pedestrian projects. Respondents answered a wide range of questions covering reasons for selecting bicycle/pedestrian projects, planning methods and resources, information sources during the planning phase, important goals and considered MOEs.



Public interest in the potential public health, environmental, equity, and monetary benefits of biking and walking has grown considerably. As indicated in the survey results, such public interest has been the primary motivator for Pennsylvania transportation planning agencies to consider bicycle and pedestrian projects. In response to this public interest, transportation planning agencies have integrated these expressed societal goals with more conventional transportation system goals, namely safety and connectivity, into a decision-making process in which bicycle and pedestrian projects are pursued based on their potential to meet societal and transportation system goals.

To establish better defined goals in Pennsylvania, the survey asked specifically which goals were considered important when making decisions about bicycle and pedestrian features. Survey respondents ranked how their organizations considered the importance of the following goals in making decisions about bicycle and pedestrian features:

- Safety
- Connectivity
- Community development
- Environmental performance
- Public health
- Equity

When considering all types of respondents, they ranked safety and connectivity as most important, followed by community development, environmental performance, public health, and equity in order of decreasing importance. There are different results from PennDOT and the MPOs/RPOs which reflect what they consider to be important MOEs. Figures 4 and 5 show these results. A total of 29 responses were received.



Figure 4

PennDOT Respondents' Ranking of MOEs Importance

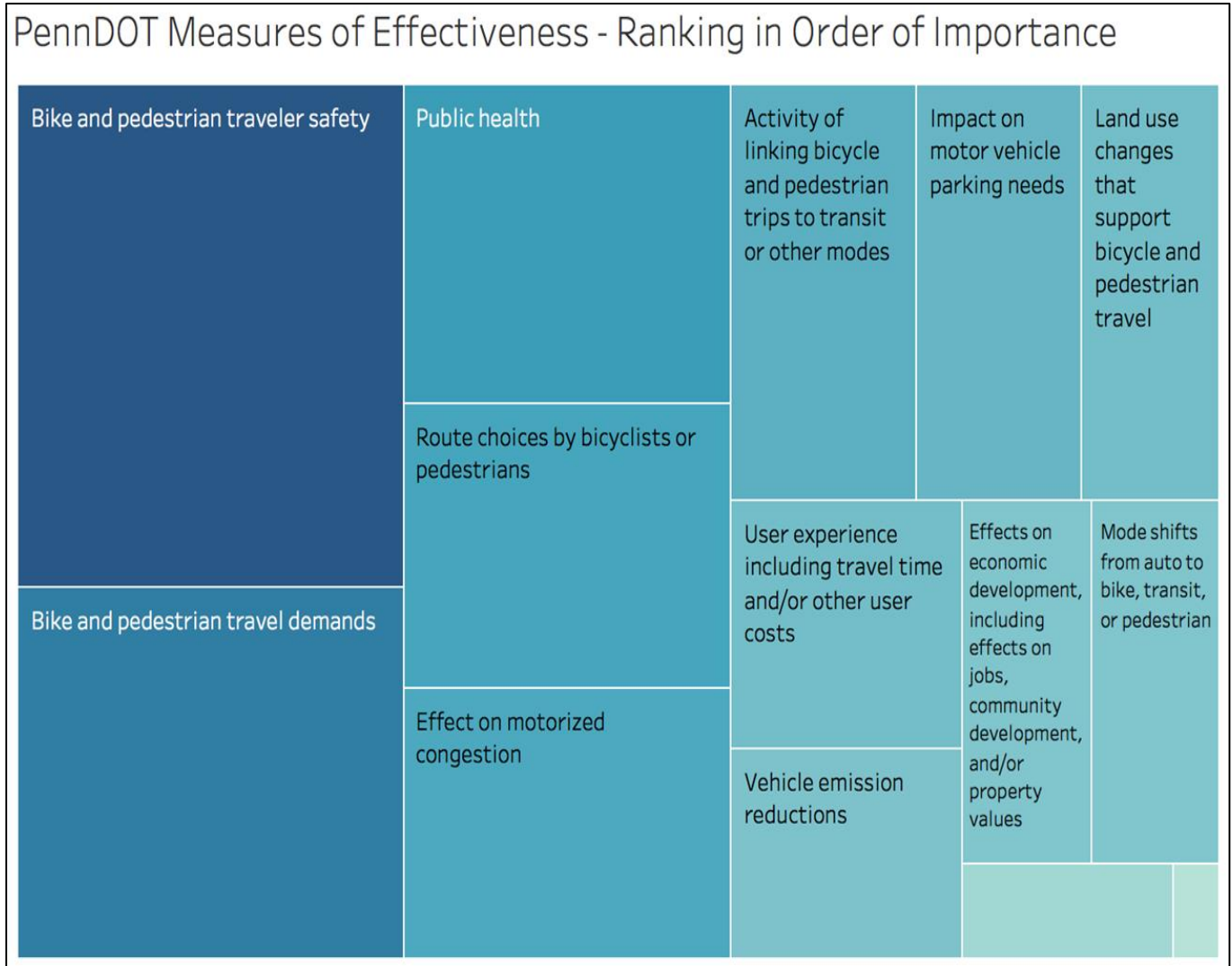


Figure 5

MPOs/RPOs Respondents' Ranking of MOEs Importance

MPO/RPO Measures of Effectiveness - Ranking in Order of Importance				
Bike and pedestrian traveler safety	Bike and pedestrian travel demands	Public health	Mode shifts from auto to bike, transit, or pedestrian	
Effects on economic development, including effects on jobs, community development, and/or property values	Activity of linking bicycle and pedestrian trips to transit or other modes	Equity	Vehicle emission	User
		Impact on motor vehicle parking needs	Energy use and fuel consumption	
Route choices by bicyclists or pedestrians	Land use changes that support bicycle and pedestrian travel	Other	Effect on motorized congestion	

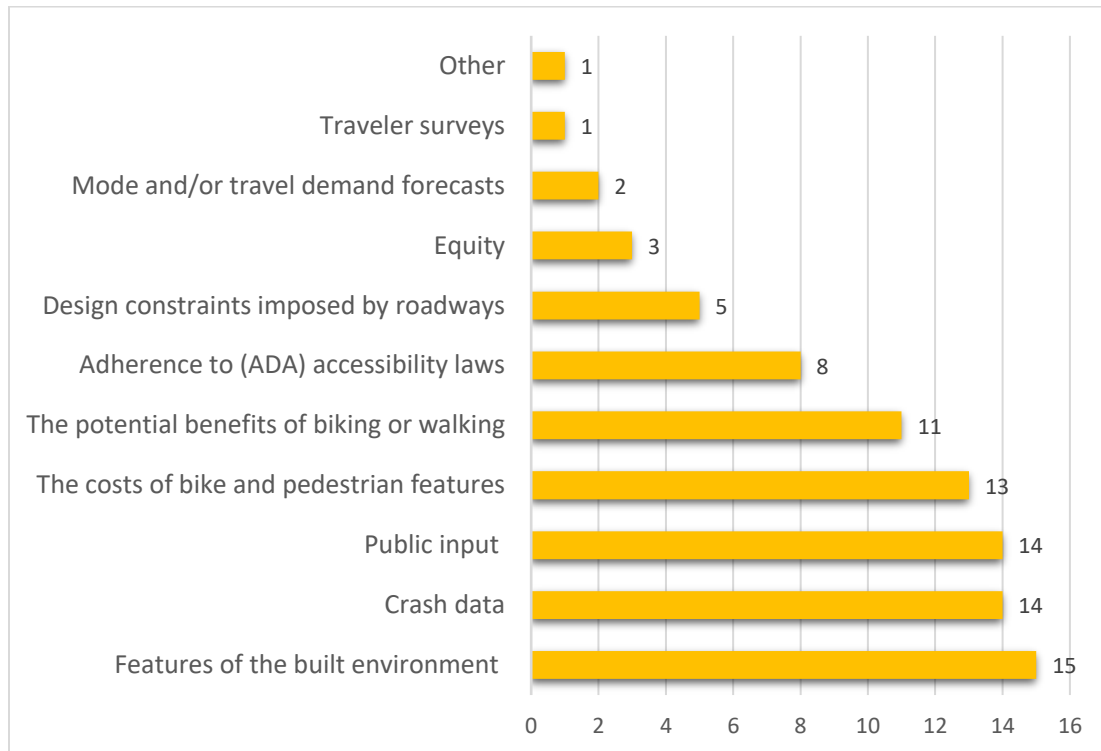
These goals generally align with those recommended by the USDOT, which include connectivity, equity, safety, health, and air quality. However, it is unclear how or if these goals connect quantitatively or qualitatively to planning and design, given an examination of the information and methods used as reported by the respondents.

To establish the current practice of what data is collected and how it is used, respondents were asked for their sources of information that they use to plan and design bicycle and



pedestrian facilities. In order of highest to lowest priority, all survey respondents indicated that they use the following sources of information, shown in Figure 6, in planning bicycle and pedestrian features. Features of the built environment were the most common consideration of organizations' planning of bike and pedestrian features closely followed by information on crash data, public input and costs of pedestrian and bike features.

Figure 6
Sources of Information Agencies Currently Use



All respondents were requested to identify their familiarity with the following planning methods: transportation demand projections, the PennDOT Design Manual, subjective ranking, benefit cost analysis, and/or transportation system analysis. However, a majority of the respondents did not identify using any planning methods for bicycle and pedestrian features. The most common planning method reported by respondents was subjective ranking.

All respondents indicated familiarity with at least one (1) of the following design methods: The Highway Capacity Manual, the PennDOT Design Manual, the PennDOT Bicycle and Pedestrian Checklist, the American Association of State and Highway Transportation Officials (AASHTO), and/or the National Association of City Transportation Officials (NACTO). However, 12 of 18 respondents indicated that they use none of these design

methods in the context of bicycle and pedestrian features. Ten (10) survey respondents indicated that they use neither an indicated planning nor design method in the context of bicycle and pedestrian features.

Pennsylvania transportation stakeholders report using a goal-oriented decision process for bicycle and pedestrian feature planning and design, and our literature review suggests Pennsylvania's process is similar to practices used elsewhere. Because of its emphasis on potential, but not modeled or previously observed travel demands, the existing goal-oriented decision process reflects unclear or missing qualitative and quantitative connections between planning and design decisions, goals, and related MOEs. The surveyed stakeholders demonstrate similar disconnects between goals, the information used for decision making, and measures of effectiveness.

In summary, the top five (5) MOEs for both PennDOT and MPO/RPO were bike and pedestrian traveler safety, effects on economic development including effects on jobs, community development and/or property values, route choices by bicyclists or pedestrians, bike and pedestrian travel demands, and public health.

III. Summary

The survey of PennDOT, MPOs and RPOs yielded valuable information on the current practices and attitudes relative to the collection and analysis of bike/ped data to support long range and project planning in Pennsylvania. These results were used to help formulate the recommendations. Significant results from the survey included:

- The survey collected a total of 29 responses: 15 MPOs, 2 RPOs, and 12 total PennDOT responses including those from District Offices and Central Office.
- The results revealed that public input was the most cited reason for both types of organizations to consider the implementation of these types of projects.
- "Ranking methods for funding of projects" was used by 7 out of 18 responders in bike and pedestrian projects.
- When asked to select up to five (5) priority sources of information their organization uses when planning bike and pedestrian features, the results for all respondents revealed that features of the built environment are the most common consideration.
- The survey results revealed that organizations are familiar with and use many planning methods and apply them to roadway projects, but few of them use any methods in bike and pedestrian projects except ranking tools. The PennDOT Design Manual, AASHTO design guides, and the PennDOT Bicycle and Pedestrian Checklist, were the most often used references for bike and pedestrian projects.



- The top three (3) goals cited by all the respondents of PennDOT and MPO/RPO for bicycle and pedestrian projects were safety, connectivity, and community development.
- The results from the survey on MOEs were ranked and indicated that safety was the highest-ranking MOE for both the planning agencies (MPOs/RPOs) and PennDOT Districts. Other high-ranking MOEs included effects on economic development, bicycle and pedestrian travel demands, public health and route choices by bicyclists.



Project Case Studies

The goal was to conduct five (5) project case studies to support the research efforts. The Pitt researchers (researchers) identified and recommended five (5) recent bicycle and pedestrian projects, which were approved by PennDOT. The case studies were conducted to understand how specific projects have used data and analysis methods to determine the goals of the projects.

I. Projects Selected for Case Studies

Five (5) case studies were investigated to identify how bicycle and pedestrian data is currently being used for project design and development. The cases were selected from those that received funding through the Transportation Improvement Program (TIP) and the Transportation Alternatives Program (TAP) or Surface Transportation Block Grant Program Transportation Alternatives Set-Aside (TA Set-Aside) that replaced TAP in 2015. One case study was also funded with Transportation Enhancements (TE) funds. The following projects were selected for the case studies.

- Monument Square, Lewistown, Mifflin County, Susquehanna Economic Development Association – Council of Governments, Metropolitan Planning Agency (SEDA-COG MPO), PennDOT District 2: A streetscape project that included installation of 22 new streetlights, as well as redesigning 9 crosswalks and narrowing streets through the installation of curb extensions to improve pedestrian safety. Phase 4 of continued work. Trade ID: PA-1178.
- Bedford Heritage Trail, Bedford Borough and Bedford Township, Bedford County, Southern Alleghenies RPO. A hike/bike trail on a 12 foot right-of-way of crushed limestone that included two bridge structures over Shobers Run on the Bedford Heritage Trail from the southern boundary of Bedford Borough. Trade ID: PA-1116.
- Lebanon City Bike Trail, Lebanon City, Lebanon County, Lebanon MPO - LEBCO, PennDOT District 8: A hike/bike trail from 9th Street to Chestnut Street in the City of Lebanon. Trade ID: PA-1104.
- Shinglehouse Trail, Shinglehouse Borough, Potter County, North Central Regional Planning and Development Commission (North Central RPO), PennDOT District 2: A streetscape/Safe Route to School installation of sidewalks in the Borough of Shinglehouse. Trade ID: PA-1224.



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- Manayunk Bridge, Philadelphia City and Lower Merion Township, Philadelphia and Montgomery Counties, Delaware Valley Regional Planning Commission (DVRPC), PennDOT District 6: A bicycle/pedestrian trail connected with bridge dedicated to trail connecting Philadelphia and Lower Merion Township. TRADE ID: PA-1207.

A summary of the case study projects is provided in Table 3. The location of the projects is shown in Figure 7.

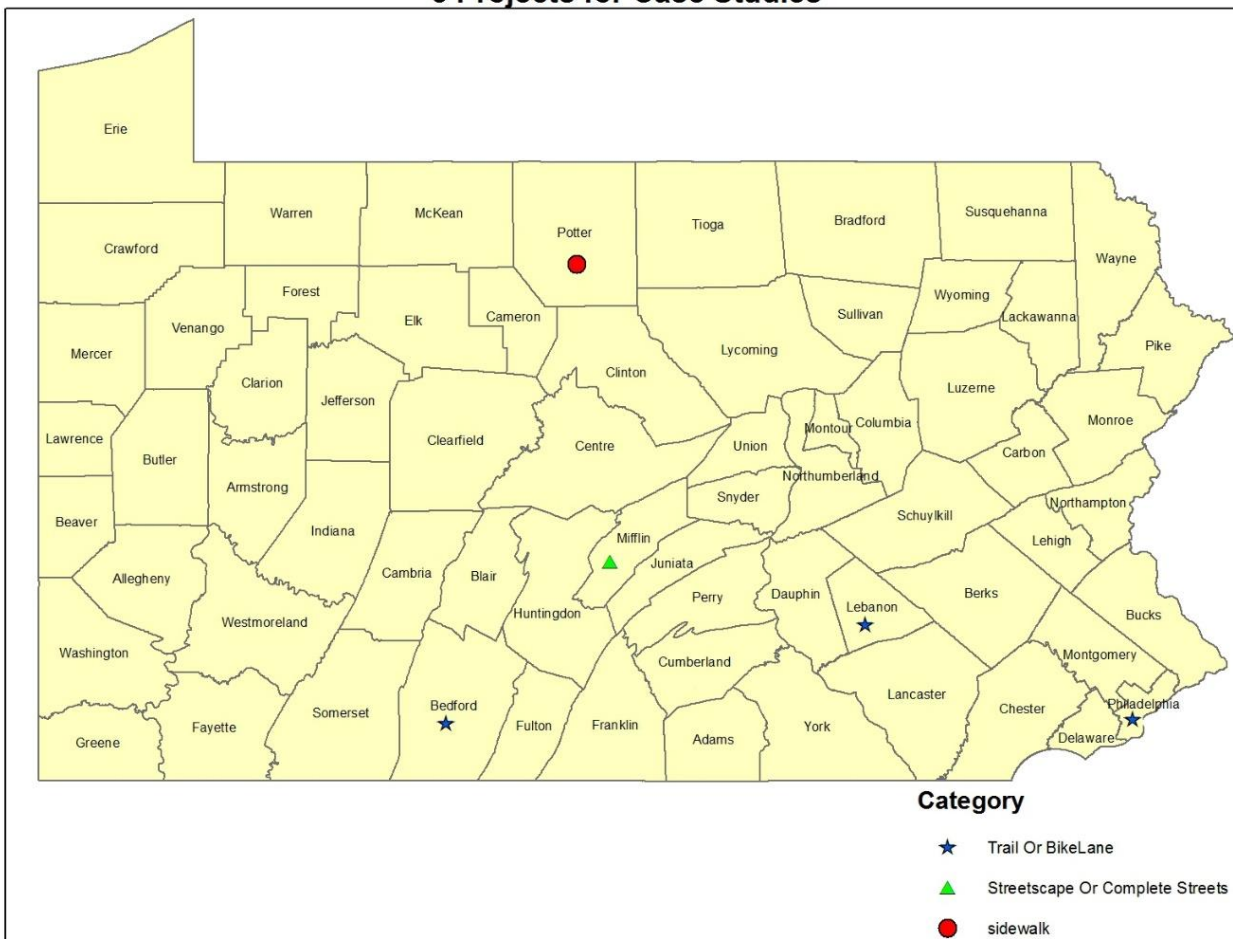
Table 3
Case Study Summary

Project Title	DOT ID	District	Planning Partner (MPO/RPO)	County	Municipality	Type of Project
Monument Square Streetscape Project Phase IV	92530	2	SEDA-COG	Mifflin	Lewistown	Streetscape
Bedford Heritage Trail	95891	9	Southern Alleghenies	Bedford	Bedford	Hike/Bike Trail
Lebanon Valley Rail Trail Phase 5	88546	8	Lebanon LEBCO	Lebanon	Lebanon	Bike Trail
Oswayo Valley SD Safe Routes to School	92519	2	North Central	Potter	Shinglehouse	Streetscape/SRTS
Schuylkill River Trail Manayunk Bridge Project	92413	6	DVRPC	Philadelphia	Philadelphia, Lower Merion Township	Bicycle/Pedestrian Trail



Figure 7
Case Study Project Locations

5 Projects for Case Studies



II. Summary of Findings

The five (5) case studies included three (3) trail projects and two (2) streetscape projects. The projects were of a significant size, \$500,000 or greater costs, and completed. The case study selections also represented projects dispersed geographically throughout the state. Two (2) projects were in urban settings: the Manayunk Bridge project and Lebanon trail project. Three (3) were in small boroughs and rural settings: Lewistown Monument Square, Bedford Trail, and the Oswayo School District project in Shinglehouse.

Funding sources for the five (5) projects included TAP and its predecessors: the Safe Routes to School and TE programs. As shown in Table 4, because the researchers examined projects that were completed, none of the projects were funded under the

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Surface Transportation Block Grant Program Transportation Alternatives Set-Aside (TA Set-Aside), which is the most recent iteration of the TE and TAP programs. Again, there were numerous local funding sources identified in the case studies to fund the design phase of the projects, noted in each case.

Across the case studies, other sources of funding included the Congestion Mitigation and Air Quality (CMAQ) program of the Federal Highway Administration and other Pennsylvania agencies, such as the Department of Community and Economic Development (DCED) and the Department of Conservation and Natural Resources (DCNR). The funding sources did not appear to have any specific requirements relative to data collection or analysis methods to be used in the development of the projects.

Table 4 Funding Sources of the Analyzed Cases

Project Title	Funding Sources
Monument Square Streetscape Project Phase IV	PennDOT PA Community Transportation Initiative (PCTI), Pennsylvania Department of Community and Economic Development (DCED), Local contributions, Liquid fuels
Bedford Heritage Trail	TE, Federal Earmark funds, DCED Greenways, Trails and Recreation Funds
Lebanon Valley Rail Trail Phase 5	TE, DCNR
Oswayo Valley SD Safe Routes to School	TE, Local funds
Schuylkill River Trail Manayunk Bridge Project	PennDOT PCTI, Surface Transportation Program (STP), Local funds, Lower Merion Township, DCNR, CMAQ

The case studies represented a variety of types of projects that accommodate bicycles and pedestrians. These projects were recommended for programming through either a MPO/RPO or a PennDOT process. Across all the projects, there was limited data collection in the planning and programming of the projects. Data collected for each project is shown in Table 5. Projects that were extending previous phases (Monument Square and Lebanon Valley Rail Trail) did not collect new data for the planning and programming phase. The Lebanon Valley Rail Trail project had safety data collected for the roadways crossings relative to traffic volumes and sight distances, along with safety



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crash data. The Oswayo Valley School District and North Central RPO were involved in collecting information from parents on student walking paths to school. Generally, for trail projects, the case studies suggest that less formal, less quantitative surveying or questionnaires are the norm for data collection.



Table 5 Data Collection for the Analyzed Cases

Project title	Data collection
Monument Square Streetscape Project Phase IV	<ul style="list-style-type: none"> • No additional pedestrian data collected for measures of success or MOEs, either before or after the project was completed
Bedford Heritage Trail	<ul style="list-style-type: none"> • Did not generate new data or additional data collection methods • Conducted a user survey
Lebanon Valley Rail Trail Phase 5	<ul style="list-style-type: none"> • Conducted a user survey • Estimated yearly trail user volumes through infrared counters • Rails to Trails group maintains informal feedback and info via its website • Collected safety data for the roadways crossings relative to traffic volumes and sight distances, along with safety crash data
Oswayo Valley SD Safe Routes to School	<ul style="list-style-type: none"> • Surveyed residents and parents to determine baseline conditions for school travel patterns • Conducted a walkability check list • Public involvement was conducted through regular meetings and the comments were included to finalize the alignment of the sidewalks and walking paths • A preliminary safety review was conducted by PennDOT and ADA criteria, crosswalk specifications were reviewed
Schuylkill River Trail Manayunk Bridge Project	<ul style="list-style-type: none"> • Conducted a postcard survey of what people would like to see on the bridge • Conducted three (3) additional meetings other than regular stakeholder meetings required by PennDOT and the City of Philadelphia to inform the public, share options, and present detailed plans • Collected additional bicycle and pedestrian count data • No additional safety data was collected beyond that already collected by local police and PennDOT • No additional surveys have been conducted since the project concept development



Most projects held meetings and made use of information collected during public meetings. Perhaps, most extensive, was the Manayunk Bridge project, which used public input to define the project.

Minimal changes were made, in general, during the design and construction phases of most projects from the original concept submitted for funding. Little new data was collected on bicycle or pedestrian parameters. But, there was nothing generalizable from these case studies on new data collected and alternatives considered during the design and construction phase. Most project designs were conceived well before the design phase.

Post project completion data collected varied by the project and local funding sources, with one common element on trail or trail connection projects: conducting user surveys or user counts. A review of the case study results reveals that few of the projects used conventional data to evaluate bicycle or pedestrian volumes, characteristics or other measures of effectiveness either prior to, during or after completion of the project. Volumes of bicycles, pedestrians and economic impact data was not typically collected.

The case studies did reveal that safety and usage were goals of the projects; however, no measures were established nor was data collected on crashes or volumes. The data that was collected during the project development and design phases of the project was primarily through the following methods:

- User surveys either before or after the project to determine design characteristics of the project or user profiles after the project
- Observation of current walking paths and routes to determine the needs and locations for walking facilities
- Public meetings to gather information on user preferences for design features or project locations

The five (5) case studies have provided valuable insight into the issues associated with the collection and usage of data for bicycle and pedestrian projects in Pennsylvania. The studies reinforced many of the goals and MOEs that the researchers identified previously through literature review, current government agency policies and surveys.



Recommendations

For the development of recommendations, the information gathered on current national and Pennsylvania practices and expectations was considered along with the survey results. The analyzed cases also contributed to development of the recommendations.

The following provides a description of the recommendations. These recommendations have been categorized by goals and MOEs first, which form the basis of a data informed decision process. The implementation of these are then supported by recommending the methods, processes and analysis methods needed to achieve these goals and report progress through the MOEs. Finally, the roles of agencies involved in the process in Pennsylvania are identified with implementation strategies.

I. Goals and Measures of Effectiveness

The most important consideration in the development of any transportation system feature is to define the goal of the system component and how to measure the achievement of these goals through specific metrics or MOEs. The evaluation of the system components, which are bicycle and pedestrian transportation infrastructure, must begin with a specific defined goal. Once the goal is established, the appropriate MOEs can be developed to measure the success of meeting that goal. Recommended goals and MOEs are provided below:

Goals

- Improve safety for bicycle and pedestrian modes of transportation
- Provide a connected system of bicycle and pedestrian networks that promotes activity for all types of trip purposes, including recreation
- Promote community development through the implementation of bicycle and pedestrian improvement projects that benefit economic development, public health, and traveler choices

Measures of Effectiveness

The recommended MOEs are intended to track the success of the goals recommended. These higher level MOEs should be considered statewide and are recommended for all agencies and all stages of project development. More detailed MOEs that are specific to agencies and phases of project development are provided later in the report.

- Measure and report safety data that reflects characteristics of changes in bicycle and pedestrian travel



- Determine the connectivity of the bicycle and pedestrian networks and track the changes to the network
- Report the measures of prioritization that projects submitted for funding scored to determine if funded projects meet the stated goals
- Track the success rate and project development time from funding to implementation for bicycle and pedestrian projects

II. Data Collection and Analysis

Data is critical for measuring the achievement of the goals and MOEs of bicycle and pedestrian systems and for the planning, design, and success of individual projects. Data will help to measure the system performance, to plan and design bicycle and pedestrian projects, to evaluate the success of the project and to measure the benefits of the implementation.

Project data should assist the planning and design of bicycle and pedestrian projects and can be used to measure the success of individual projects. Once a specific project need has been identified, additional data and analysis is needed during the planning phase to determine the concept and program cost of the project. Data to define the concept of a project is also important. The responsibilities for these actions were categorized by the agencies involved in these projects including PennDOT, MPOs/RPOs and local governments. The recommendations follow below:

- Develop an improved and enhanced database of information for pedestrian and bicycle crashes.
- Develop bicycle and pedestrian data publication standards (manual) for reporting, sample data conversion and provide a centralized repository for all data.
- If a project is being developed and designed by PennDOT, measure existing bicycle and pedestrian usage in the project area. Determine the number, type and causation factors of bicycle and pedestrian crashes and conduct an inventory or obtain data on the current roadway and right-of-way features in the project area.
- Develop an improved database of information for connectivity of the current built environment and current pedestrian/bicycle travel infrastructure.
- Support the planning phase for project development and create an asset management system tool for the current roadway and right-of-way features in the project area.
- After a project is completed, an evaluation should be conducted to determine if the project met the expectations in terms of usage and safety.



- Develop and implement a regional data collection plan for bicycle and pedestrian usage, including permanent count stations for short term data adjustment factors.
- Create an asset management tool that measures the built environment to identify latent demand links and modes for the region.
- When developing projects, measure existing bicycle and pedestrian usage in the project area. Determine the number, type and causation factors of bicycle and pedestrian crashes and conduct an inventory or obtain data on the current roadway and right-of-way features in the project area.

III. Long Range Planning Goals

MPOs and RPOs use the long-range transportation planning process to forecast usage and deficiencies of the transportation network. This role has been well established for vehicular and transit modes, but is largely undetermined for bicycle and pedestrian modes of travel. The following recommendations are made for long range planning.

- Adopt a bicycle and pedestrian project prioritization method to be used by PennDOT and all MPOs/RPOs for review of funding applications.
- Improve the delivery of bicycle and pedestrian projects and track time of delivery as an MOE.
- Develop a resolution of the issue of ownership for sidewalks and bicycle lanes on state highways. Current law requires local municipalities to take ownership responsibility, which has deterred advancement of projects.
- Improve the delivery of bicycle and pedestrian projects by setting TIP schedules that are realistic relative to the complexity of the project.
- To improve the delivery of bicycle and pedestrian projects, conduct comprehensive network evaluations prior to the submission of funding applications.

IV. Summary

Recommendations have been developed in the following areas to enhance bicycle and pedestrian data collection, methods of analysis, project development and system performance evaluations: goals and MOEs, data collection and analysis, long range transportation planning, the project development process and agencies' roles.

The recommendations for goals and MOEs are summarized as follows. Additionally, implementation actions for each agency have been identified.



Goals:

- Improve safety for cyclists and pedestrians
- Provide a connected system of bicycle and pedestrian networks
- Promote community development through the implementation of bicycle and pedestrian improvement projects

MOEs:

- Document characteristics, such as safety and activity levels, of changes in bicycle and pedestrian travel
- Measure changes over time to the connectivity of the bicycle and pedestrian networks
- Report project prioritization funding scores to determine if funded projects meet the stated goals
- Monitor the success rate and project development time from funding to implementation for bicycle and pedestrian projects

PennDOT Implementation Actions:

- Develop an improved and enhanced database of information for pedestrian and bicycle crashes
- Adopt a bicycle and pedestrian project prioritization method to be used by PennDOT and all MPOs/RPOs for review of funding applications
- Develop bicycle and pedestrian data publication standards (manual) for reporting and sample data conversion and provide a centralized repository for all data
- Improve the delivery of bicycle and pedestrian projects and track time of delivery as an MOE
- Develop a resolution of the issue of ownership for sidewalks and bicycle lanes on state highways. Current law requires local municipalities to take ownership responsibility, which has deterred advancement of projects.
- If a project is being developed and designed by PennDOT, measure existing bicycle and pedestrian usage in the project area. Determine the number, type and causation factors of bicycle and pedestrian crashes and conduct an inventory or obtain data on the current roadway and right-of-way features in the project area.



MPO/RPO Implementation Actions:

- Develop an improved database of information for connectivity of the current built environment and current pedestrian/bicycle travel infrastructure
- Improve the delivery of bicycle and pedestrian projects by setting TIP schedules that are realistic relative to the complexity of the project
- Support the planning phase for project development and create an asset management system tool for the current roadway and right-of-way features in the project area
- After a project is completed, an evaluation should be conducted to determine if the project met the expectations in terms of usage and safety
- Develop and implement a regional data collection plan for bicycle and pedestrian usage, including permanent count stations for short term data adjustment factors
- Create an asset management tool that measures the built environment to identify latent demand links and modes for the region

Local Government Implementation Actions:

- To improve the delivery of bicycle and pedestrian projects, conduct comprehensive network evaluations prior to the submission of funding applications
- When developing projects, measure existing bicycle and pedestrian usage in the project area. Determine the number, type and causation factors of bicycle and pedestrian crashes and conduct an inventory or obtain data on the current roadway and right-of-way features in the project area





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